MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2021/2022

DEE5066 – INDUSTRIAL ELECTRONICS

(Diploma in Electronic Engineering)

09 AUGUST 2022
9.00 a.m. - 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 6 pages excluding the cover page with 5 Questions only.

2. Attempt **ALL** the questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

Question 1

a)

i. Write the Boolean Expression for the logic circuit shown below in Figure-1(a). [2 Marks]

ii. Draw the PLC Ladder Diagram for the Boolean expression obtained in (i). [2 Marks]

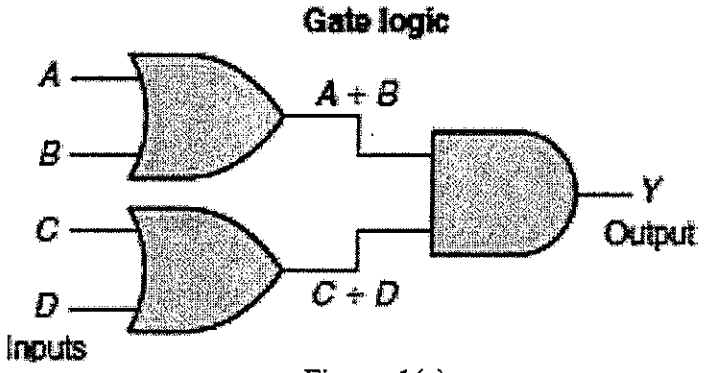

Figure-1(a)

b)

i. Consider the following condition in an assembly line of beverage packaging company as shown in Figure-1(b). A conveyer is used to transfer a bottle from one location to another. A control circuit is used to detect the number of bottles being carried on the assembly line. When it counts 12 bottles, the circuit stops the conveyor. Design the PLC ladder diagram for the above scenario. [5 Marks]

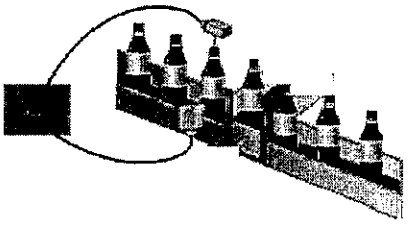

Figure-1(b)

Continued...

ii. When the conveyor is stopped, the circuit will turn on a red indicator light for 20 seconds for the intervention of operator. After that, the conveyer is restarted. [5 Marks]

Use the following Table-1 for I/O assignments:

Table-1

Components	Label
Sensor	0.01
Counter	CNT 0
Conveyor	1.00
Timer	TIM 0
Red Indicator Light	1.01

c)

An escalator in a shopping complex is designed to have a switch (SW) to control its motor (M) as shown in the PLC ladder in Figure-1(c). For each of the following cases, modify the rung of the ladder diagram accordingly. Consider each case separately as they are not related to each other.

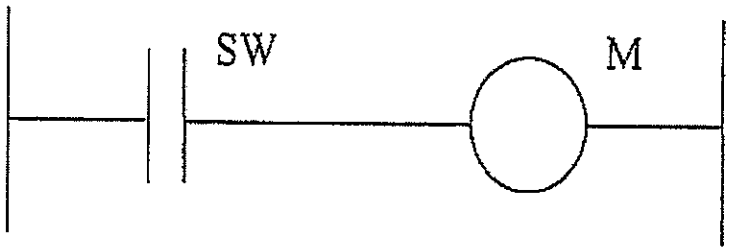

Figure-1(c)

i. Start the escalator once the switch is momentarily pressed. [2 Marks]

ii. Assume the motor is running and latched. Now, add a stop switch(STOP) in order to turn it off during shutdown or emergency. [2 Marks]

iii. Add a motion sensor (MS) to detect people approaching the escalator so that the motor can be turned on automatically, besides using the manual switch. [2 Marks]

Continued ...

Question 2

Refer to the relaxation oscillator as shown in Figure-2. The following values are given: $V_{DC} = 20V$, $R = 50k\Omega$, $R_1 = 0.1k\Omega$, $C = 100nF$, $r_{BB} = 4k\Omega$, $\eta = 0.6$, $V_v = 3V$, $I_v = 10mA$ and $I_p = 10\mu A$.

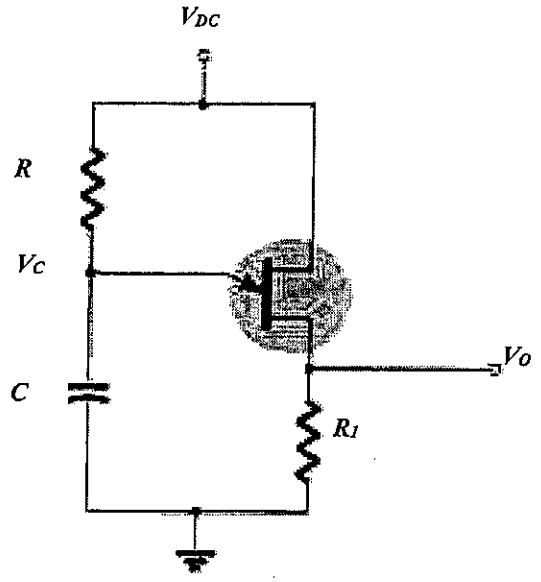

Figure-2

i. Determine r_{B1} and r_{B2} at $I_E = 0A$. [4 Marks]

ii. Calculate V_P, the necessary voltage to turn on the UJT. [4 Marks]

iii. Determine whether R is within the permissible range to ensure firing of the UJT (ON state). [5 Marks]

iv. Determine the frequency of oscillation if $r_{B1} = 100\Omega$ during the discharge phase. [5 Marks]

v. Sketch the waveform across the capacitor. [2 Marks]

Continued ...

Question 3

a)
A resistance-temperature detector (RTD) has $\alpha(20°C) = 0.004/°C$ satisfying the equation: $R(T) = R(T_0)[1 + \alpha(T - T_0)]$

i. If the RTD has a resistance of 106Ω at 20°C, find its resistance at 25°C.

ii. Assume the RTD has a dissipation constant of 25mW/°C and is used in a circuit that puts 8mA through the sensor. If the RTD is placed in a bath at 100°C, What resistance will the RTD have?

iii. What is the indicated temperature? [8 Marks]

b)
Determine the output voltage of the temperature-measuring bridge circuit in Figure-3(b) if the thermistor is exposed to a temperature of $50^{\circ}C$ and its resistance at $25^{\circ}C$ is $1.0k\Omega$. Assume the resistance of the thermistor decreases to 900Ω at $50^{\circ}C$. [8 Marks]

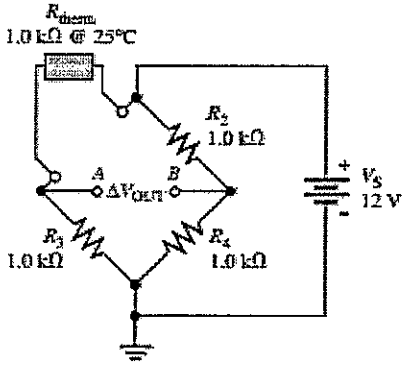

Figure-3(b)

ic)

If $\beta = 4350K$ and $R_O = 3000\Omega$ at $T_O = 298K$, determine the resistance of a thermistor at$150°C$. [4 Marks]

Continued ...

Question 4

a)
An optical shaft-encoder has a 10:1 gear ratio, an optical disc with 60 slits and a 9-bit binary counter.

i. How much movement of the measured shaft is required to cause the counter to increment by 1 bit? [4 Marks]

ii. If the measured shaft moves 180° from its prior position, what is the content of the binary counter? [3 Marks]

iii. What is the maximum allowable shaft motion to ensure that the counter never exceed its capacity? [4 Marks]

iv. What amount of shaft movement is represented by a binary output of 11100 0011? [2 Marks]

b)
The optical shaft-encoder in Question Q4(a) has a direction-indicating ability. Its output is a 9-bit signed magnitude binary, with the 9th bit Most Significant Bit (MSB) representing either sign bit 0 for positive (disc rotating clockwise), or 1 for negative (disc rotating counterclockwise).

i. What is the maximum allowable shaft movement to ensure that the counter never exceed its capacity? [3 Marks]

ii. What is the magnitude and direction of the measured shaft movement for a binary output of $[01011\ 1110]_2$? [2 Marks]

iii. What is the magnitude and direction of the measured shaft movement for a binary output of $[10111\ 1001]_2$? [2 Marks]

Continued ...

Question 5

a)

Explain briefly the principle of operation of the DC Motor with a neat diagram. The motor components should be clearly labeled. [6 Marks]

b)

Suppose that a shunt-configured DC motor has an armature winding resistance $R_A = 2.8\Omega$, an applied voltage $V_A = 230V$, a field winding resistance $R_F = 169\Omega$, a rotational speed S = 2400 r/min, a magnetic field strength $B = 0.95T$ and $k_t = 0.83$. If the motor generates 226.22V, find the following.

i. The armature current. [2 Marks]

ii. The motor's mechanical power. [8 Marks]

iii. The motor's proportionality factor $k_{E_{C3}}$. [4 Marks]

End of Paper